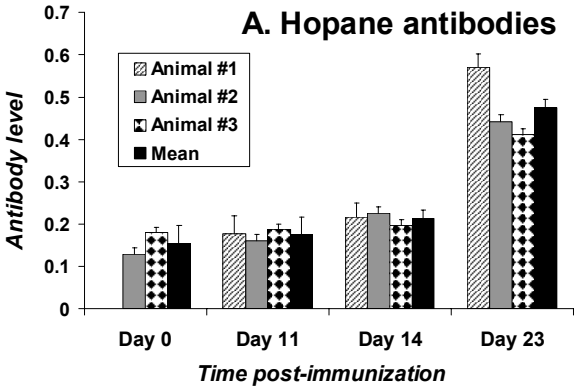
A NEW ANTIBODY FOR CATEGORY 1 BIOMARKER DETECTION. J. Maule[1,2], A. Steele[2], J. Toporski[2], D. S. McKay [1]. [1]Astromaterials and Exploration Science, NASA Johnson Space Center, Houston, TX. (jake.maule@jsc.nasa.gov), [2]Geophysical Laboratory, Carnegie Institution, Washington DC

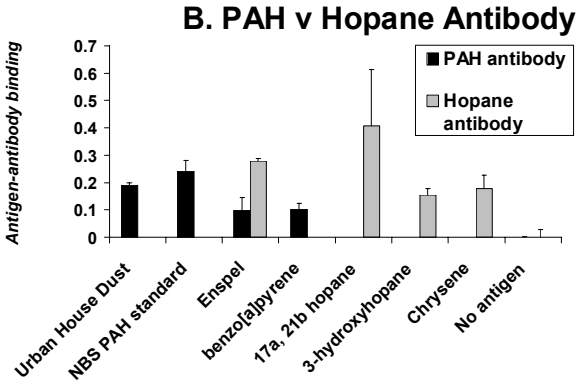
Introduction: At least two questions arise in developing a life-detection strategy: What do we look for and what will positive detection tell us? Unfortunately, many "biomarkers" are not conclusive markers of biology. For example, sugars [1], amino acids [2], polycyclic aromatic hydrocarbons (PAH) [3] and certain bacteria-like morphologies can all be produced non-biologically. Inferences of life following the detection of several inconclusive biomarkers in one sample will always be questioned. Although DNA, RNA and proteins are excellent markers of biology, and preserved on Earth for several millions of years [4-6], their survival over longer periods of time is low. Ideally, we should target biomarkers which are both stable over time and formed exclusively from biological processes, i.e. a "category 1" biomarker under the new classification system of Mckay [7].

Category 1 biomarkers: Potential candidates include two types of aromatic hydrocarbon: hopane (2-α-methylhopanes) and sterane (cholestane), derived from bacterial [8-11] and eukaryotic membranes [12, 13], respectively. They are stable under high temperature and pressure [14] and have been found in 2.7 billion year-old rocks [13] using GCMS.

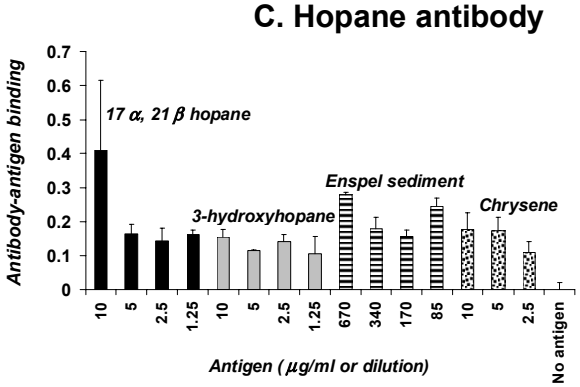
Antibodies: As an alternative and possibly more sensitive [15] tool, we proposed a new lightweight anti-hopane-detection system for spaceflight, using anti-hopane antibodies. Given that none existed, we generated new anti-hopane polyclonal antibodies [16], using a method previously used to generate antibodies to serotonin [17]. Enzyme-linked immuno-sorbent assay (ELISA) showed increasing levels of anti-hopane antibody in serum with time (Figure A).



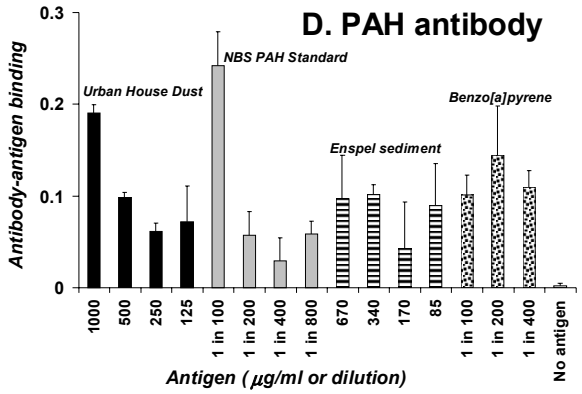
We are currently able to detect hopane in a rock sample diluted to 90μg of material/ml solvent (lower than 1μg/ml, see Figure B), using a single-step extraction lasting 10-30 minutes.



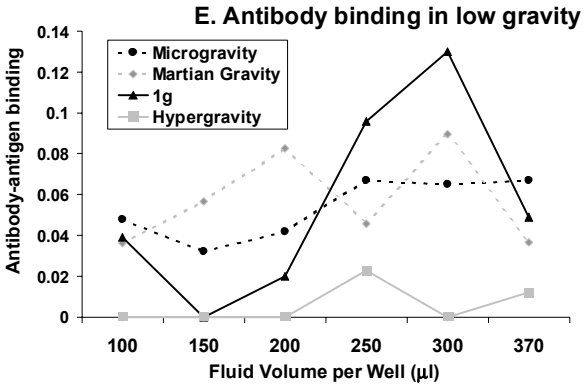
The same technique was used with a commercially available anti-PAH antibody (BAP-13), to detect equivalent levels of PAH in standards and rock extract (see figure C).



Hopane antibodies reacted with 3-hydroxyhopane, αβ hopane and sediments from the Enspel formation, Germany - known to contain high levels of hopane (Jan Toporski, personal communication). Little cross-reactivity was observed between hopane antibodies and BAP-13 (Figure D).



Low gravity: The fluid-based assays used with antibodies must work during microgravity and martian gravity if they are to be chosen for spaceflight. We tested ELISA in these conditions, using the NASA KC-135 aircraft, showing that antibody-antigen binding in microgravity and 0.4g compared favorably with 1g (see figure E) [18].



Conclusion: We have used antibodies to detect category 1 and other biomarkers in rock samples. Extraction takes a few minutes and analysis a few hours. We have presented use of new antibodies to detect hopanes and have shown proof of operation during martian gravity.

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